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Abstract

Economic models of crime and punishment implicitly assume that the government can credibly commit to the fines, sentences, and apprehension rates it has chosen. We study the government's problem when credibility is an issue. We find that several of the standard predictions of the economic model of crime and punishment are robust to commitment, but that credibility may in some cases result in lower apprehension rates, and hence a higher crime rate, compared to the static version of the model.

Journal of Economic Literature Classification: K14, K42

Keywords: Economics of Crime, Credible Commitment, Time Consistency

Credible Criminal Enforcement

1. Introduction

The interaction between government and criminals follows a natural sequential structure. The government sets fines, sentences, and apprehension rates, which are observed by potential criminals, who then decide to whether or not to engage in criminal acts. Once a crime has been committed, the government has to carry out its promised policy. While this sequence of events describing the interactions between criminals and policy-makers is obvious, it is typically suppressed in economic models of crime and punishment. This is tantamount to assuming that government policies are credible, and that the government faces no pressure to deviate from its enforcement plans once they are announced.

The potential difficulty is that, once a criminal has decided whether or not to commit a crime given the government's announced punishment plan, the social benefits from the enforcement policy have been completely realized with respect to that individual. And because apprehension of criminals is costly, the government may have an incentive to renege on the announced policy. In this way, the government may reap the full benefits from the policy, while at the same time avoiding some enforcement costs. The government faces essentially the same credibility issues when deciding how severely to punish a criminal once he is apprehended. Of course, criminal enforcement is not a one-shot game but is repeated with each offense that is committed. Thus, the government's behavior at any point in time is a signal of what it will do in the future, which allows it to establish a reputation for credibility.

With these issues in mind, we study the standard economic model of crime and punishment within the context of an infinitely-repeated stage game played by potential criminals and the government. The methodology is essentially the same employed in the study of time-consistent policy in macroeconomics.[1] Somewhat surprisingly, we find that the optimal static enforcement policies – maximal fines and jail sentences, with minimal apprehension probabilities[2] – are, under plausible conditions, generally credible. We do find, however, that commitment problems may result in lower apprehension probabilities compared to the static model. These results are developed in the paper as follows. Section 2 presents the model, section 3 examines a fine-only punishment regime, and section 4 expands the model to include jail sentences. Finally, section 5 concludes.

2. The Model

Social welfare is written as follows:

$$W = \int_{q(f+j)}^{\infty} (b-D)dG(b) - [1-G(q(f+j))]q\alpha j - c(q)$$

$$= H(q(f+j)) - [1- G(q(f+j))]q\alpha j - c(q) \qquad (1)$$

where

q=probability of apprehension and conviction;

f=fine upon conviction;

j=jail term as measured by the disutility to offenders;

α=unit cost to society of j;

[1] The literature begins with Kydland and Prescott (1977). See Ljungqvist and Sargent (2000), Chapter 16, for an overview. Rogoff (1989) surveys the literature.
[2] The seminal paper is Becker (1968); see the recent review article by Polinsky and Shavell (2000) for a comprehensive discussion.

b=offender's benefit of committing a crime, distributed according to $G(b)$;

D=damages caused by crime.

In (1), the $H(\cdot)$ function captures the net benefits of deterrence, the second term is the expected cost of imposing a jail sentence, and the final term is the cost of apprehension. Standard economic models of criminal enforcement view the enforcer as choosing $q, f,$ and j to maximize (1) subject to $f \leq f_m$ and $j \leq j_m$, where f_m and j_m are upper bounds on the fine and jail term. (For example, f_m could be the offender's wealth and j_m his life span.)

The following results are well-established in the literature on optimal criminal enforcement (Polinsky and Shavell, 2000). First, when a fine is used, whether or not in combination with jail, it is always optimal to set $f=f_m$ since there is no social cost of increasing the fine. Second, if jail alone is used in combination with q (i.e., $f \equiv 0$), it is also optimal to set $j=j_m$. Even though jail is costly, only convicted offenders are imprisoned. Thus, by raising j and lowering q to keep qj constant, deterrence and expected punishment costs remain the same, but enforcement costs fall. As a result, welfare is increased by raising j as high as possible. Finally, if jail and fines are both used in combination with q, optimal punishment continues to require $f=f_m$, but it is no longer necessarily optimal to set $j=j_m$.

What this static model ignores, and what has apparently not been addressed in the literature, is the possible time-inconsistency problem in criminal enforcement. That is, it may not be optimal for the enforcement authority to carry out the announced policy as described above. Although this problem may not arise for fines because they are costless to impose, it is a potentially serious problem for the announced apprehension rate and jail term because, once a crime has been committed, it is costly to carry out these threats. Thus, there may be an incentive to renege on the optimal policy.

To illustrate, suppose the enforcement authority announces the optimal static policy (q^*, f_m, j^*) as described above. If the policy is believable, offenders respond by committing crimes if $b \geq q^*(f_m + j^*)$, which achieves the desired level of deterrence. It is now up to the enforcer to actually carry out the policy given that some crimes have been committed. If it does, realized welfare is

$$W(q^*, f_m, j^*) = H(q^*(f_m + j^*)) - [1 - G(q^*(f_m + j^*))]q^* \alpha j^* - c(q^*) \qquad (2)$$

which is just (1) evaluated at the optimal policy. However, if the enforcer reneges on the policy by setting q=0, realized social welfare is

$$\widetilde{W}(q^*, f_m, j^*) = H(q^*(f_m + j^*)) \qquad (3)$$

which clearly is higher than (2) since the costs of apprehension and imprisonment are avoided.

The problem, of course, is that offenders will anticipate the enforcer's strategy and behave as if q=0, regardless of the announced policy. In that case, offenders will commit crimes if b>0, and realized social welfare will be

$$\hat{W}(q^*, f_m, j^*) = H(0) \qquad (4)$$

which must be less than $\widetilde{W}(q^*, f_m, j^*)$ for q^*>0.

In the static model of law enforcement, this credibility problem is ignored. Here we explicitly address it in the context of a dynamic (multi-period) model in which the enforcer seeks to establish a reputation for carrying out its promised policy. Our methodology is essentially that described in Lungqvist and Sargent (2000). Specifically, consider the following sequence of events:

1. The enforcer announces a policy (q,f,j), where $q \in [0,1]$, $f \in [0,f_m]$, and $j \in [0,j_m]$;
2. Potential offenders decide whether or not to commit crimes;
3. The enforcer decides whether or not to carry out the announced policy;
4. The sequence repeats in the next period.

In this context, we look for an enforcement policy (or set of policies) that the enforcer will credibly carry out over an infinite time horizon. A credible policy is one for which the present value of social welfare from continued adherence to the policy exceeds the one-time gain from deviating. For an arbitrary announced policy (q,f,j), the present value of adherence forever equals

$$W(q,f,j) + \delta W(q,f,j) + \delta^2 W(q,f,j) + \ldots = \frac{W(q,f,j)}{1-\delta} \tag{5}$$

where $\delta<1$ is the discount factor. Recall that reneging on the policy involves setting q and/or j=0 to save on enforcement costs,[3] given that crimes have already been committed in the current period. This yields welfare of $\widetilde{W}(q,f,j)$ in the current period but $\hat{W}(q,f,j)$ in all periods thereafter as offenders correctly anticipate the enforcer's strategy. The present value of this strategy over an infinite horizon is

$$\widetilde{W}(q,f,j) + \delta\hat{W}(q,f,j) + \delta^2\hat{W}(q,f,j) + \ldots = \widetilde{W}(q,f,j) + \frac{\delta\hat{W}(q,f,j)}{1-\delta}$$

After substituting from (3) and (4), this becomes

$$H(q(f+j)) + \frac{\delta H(0)}{1-\delta} \tag{6}$$

The announced policy is enforceable if (5) exceeds (6), or, after rearranging, if

$$W(q,f,j) \geq (1-\delta)H(q(f+j)) + \delta H(0) \tag{7}$$

[3] Obviously, once q=0, the value of j becomes irrelevant.

We will refer to (7) as the *credibility condition*. (Note that the left-hand side of this condition is itself social welfare.) In the dynamic model, the optimal enforcement policy involves choosing q, f, and j to maximize welfare in (1) subject to (7).

3. Fines Alone

We first examine a fine-only punishment scheme (i.e., $j \equiv 0$). Recall that there is no commitment problem regarding the magnitude of f since it is costless to impose. In this sense, $f=f_m$ is consistent with a credible policy. The question therefore solely concerns the choice of q.

Social welfare in this case is

$$W(q,f_m,0) = H(qf_m) - c(q) \tag{8}$$

while the credibility condition is

$$H(qf_m) - c(q) \geq (1-\delta)H(qf_m) + \delta H(0) \tag{9}$$

Our principal result is as follows:

Proposition 1: In a fine-only punishment scheme, the optimal static policy (q^*,f_m) is credible if and only if the discount factor exceeds a critical value δ_c that is strictly between zero and one.

Proof: We first show that (9), evaluated at the optimal static policy, holds for $\delta=1$ but not for $\delta=0$. When $\delta=1$ (9) becomes

$$H(q^*f_m) - c(q^*) \geq H(0)$$

which holds for $q^* \geq 0$, whereas for $\delta=0$ (9) is

$$H(q^*f_m) - c(q^*) \geq H(q^*f_m)$$

which clearly does not hold for $q^*>0$. Now, since the right-hand side of (9) is decreasing in δ (given $H(q^* f_m)>H(0)$), there exists a critical value δ_c, strictly between zero and one, such that (9) holds for $\delta \geq \delta_c$ but does not hold for $\delta < \delta_c$. Q.E.D.

As an example, let b be uniformly distributed on $[0, \bar{b}\,]$ and let $c(q)=q^2/2$. In this case, the optimal apprehension rate in the static model, found by maximizing (8), is

$$q^* = \frac{Df_m}{\bar{b} + f_m^{\;2}}\,. \tag{10}$$

Substituting this value for q into the credibility condition (9) and re-arranging shows that (q^*, f_m) is credible in this example if and only if

$$\delta \geq \frac{\bar{b}}{2\bar{b} + f_m^{\;2}} \equiv \delta_c\,, \tag{11}$$

where δ_c is clearly between zero and one. Note that δ_c is increasing in $\bar{b}$ and decreasing in f_m. Thus, an increase in the upper bound on b makes it less likely that q^* is supportable as an equilibrium. This is true because a larger $\bar{b}$ increases the social benefit of crime and hence reduces the value of deterrence. In contrast, an increase in the maximum possible fine makes it easier to support q^* as an equilibrium. This is true because the larger maximal fine reduces the enforcer's need to rely on costly apprehension to achieve a given level of deterrence.

Figure 1 illustrates Proposition 1 for the general case. The curve labeled W represents social welfare and also the left-hand side of the credibility condition (9), while the curves labeled by δ represent different values for the right-hand side of (9).[4] Note that these curves shift up as δ decreases. While the static optimum q^* occurs at the highest point on the W curve, the dynamic optimum occurs at the highest point on W such that W is above the corresponding δ-curve. As Proposition 1 showed, this optimum coincides with the static optimum (q^*) for $\delta \geq \delta_c$, but for lower values of δ, the dynamically optimal apprehension rate is lower than q^*. Thus, for $\delta < \delta_c$, the crime rate in the dynamic model will be higher than in the static model.

To illustrate in the context of the uniform distribution example from above, for a sufficiently small value of δ so that constraint (9) binds we can solve (9) directly for the optimal apprehension rate:

$$q'(\delta) = \frac{2\delta D f_m}{\bar{b} + \delta f_m^{\ 2}} \tag{12}$$

This rate is positively related to the discount factor and goes to zero as δ goes to zero. Thus, since the fine is fixed at its maximum value, the apprehension rate also falls as the discount factor gets smaller. Finally, it is easy to verify that $q'(\delta_c)=q^*$.

4. Jail

The addition of jail as a punishment option (with or without a fine) complicates matters because it adds another stage to the enforcement decision. Specifically, once an offender has been apprehended, it may not be credible to impose the promised jail term. To examine this additional credibility problem, we begin with the case of jail alone ($f \equiv 0$) and ask whether a maximal jail term ($j=j_m$) is optimal as in the static model. Later, we consider jail in combination with fines.

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[4] For $\delta<1$, the δ-curve reaches a maximum at the point where $H'(qf_m)=0$. Using the definition of $H(\cdot)$, this

A. Jail Alone

Consider an announced policy (q,j). From (7), credibility of the overall policy (with f=0) requires that

$$H(qj)-[1-G(qj)]q\alpha j-c(q)\geq(1-\delta)H(qj)+\delta H(0) \tag{13}$$

where the left-hand side of (13) is also welfare in this context. Now suppose that an offender has been apprehended. If the enforcer imposes the announced jail term, realized welfare is $W(q,0,j)$. However if he reneges, realized welfare is

$$\widetilde{W}(q,0,j)-c(q)=H(qj)-c(q) \tag{14}$$

which differs from (3) by the subtraction of $c(q)$, reflecting the sunk cost of apprehension. Failure to impose j at this point saves punishment costs, but realized welfare in all subsequent periods is

$$\hat{W}(q,0,j)-c(q)=H(0)-c(q) \tag{15}$$

Using these expressions to form the credibility conditions for j yields

$$H(qj)-[1-G(qj)]q\alpha j\geq(1-\delta)H(qj)+\delta H(0) \tag{16}$$

It should be clear that (13) implies (16) because $c(q)$ is not subtracted from the left-hand side of (16). Thus, we have

Lemma 1: In a jail-only punishment scheme, if (q,j) is a credible enforcement policy before apprehension, then j is credible after apprehension.

It follows that in deriving the optimal dynamic policy involving jail we can ignore (16) and simply maximize welfare subject to (13). Given this, we have the following result:

Proposition 2: In a jail-only punishment scheme, the optimal dynamic policy involves $j=j_m$; that is, the jail term is maximal.

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occurs where $q=D/f_m$ as shown in Figure 1.

Proof: Suppose $j<j_m$. Now lower q and raise j so that the expected jail term, qj, remains constant. Note that this increases the left-hand side of (13) (because apprehension costs fall while expected punishment costs and deterrence remain constant), whereas the right-hand side is unchanged. Thus, welfare increases without violating the credibility condition. It follows that $j<j_m$ could not have been optimal. Q.E.D.

This result shows that the optimal static policy of imposing a maximal jail term is also credible in the dynamic model. However, as in the fine-only case, the optimal apprehension rate may be lower than in the static model, in which case case the crime rate will be higher.

B. Fines and Jail

Finally, consider the most general case in which the enforcer can use fines in combination with jail. Observe first that, for reasons noted above, the fine should always be set at its maximal level before any jail term is imposed. Thus, given $f=f_m$, q and j are chosen simultaneously to maximize welfare subject to credibility.

As we showed in the jail-only case, credibility of the overall policy (q,f_m,j) is sufficient to ensure credibility of j once the offender is apprehended. (That is, lemma 1 holds here as well.) The optimal dynamic policy therefore maximizes

$$H(q(f_m+j))-[1-G(q(f_m+j))]q\alpha j-c(q) \tag{17}$$

subject to

$$H(q(f_m+j))-[1-G(q(f_m+j)]q\alpha j-c(q)\geq(1-\delta)H(q(f_m+j))+\delta H(0) \tag{18}$$

As noted above, it is not generally true in the static model that the optimal jail term is maximal when both fines and jail are used. Thus, let the optimal static policy (i.e., the policy that maximizes (17)) be given by (q^*, f_m, j^*) where $q^*>0$ and $j^* \leq j_m$. Then we can prove the analog to Proposition 1:

Proposition 3: In the general enforcement scheme, the optimal static policy (q^*, f_m, j^*) is credible if and only if δ exceeds a critical value that is strictly between zero and one.

Proof: Clearly, (18) holds if $\delta=1$ but not for $\delta=0$ (given $q^*>0$). And since the right-hand side of (18) is decreasing in δ, there exists a critical value of δ strictly between zero and one such that (18) holds if and only if δ exceeds this value. Q.E.D.

Based on this result, the optimal dynamic policy entails an expected punishment $q(f_m+j) \leq q^*(f_m+j^*)$. Thus, as in all previous cases, the crime rate in the dynamic model will tend to be higher than in the static model, again reflecting the cost of credibility.

5. Conclusions

Our results demonstrate that commitment issues do not fundamentally change optimal fines and sentences derived in the standard static economic model of crime and punishment. In retrospect, this is not surprising as the essential economic effect driving the static model has not changed: it is still the case that, by raising fines/sentences and lowering apprehension rates, the government can most cheaply maintain a level of deterrence while at the same time lowering the costs of enforcing it.

We do find, however, that when the government is sufficiently short-cited, the probability of apprehension will be lower than in the traditional static model. Further, the more heavily the government weighs the present relative to the future, the lower will be the apprehension rate and the higher will be the crime rate.

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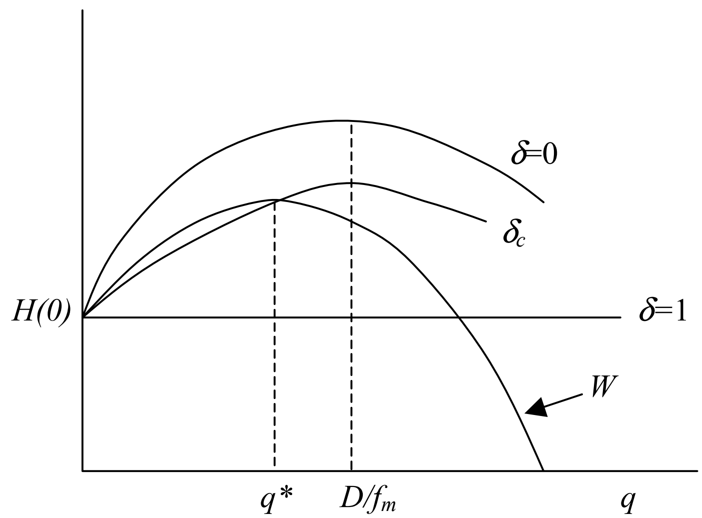

Figure 1. Condition for the optimal static apprehension rate to be credible.